Environmental Protection Division

BROOKHAVEN
NATIONAL LABORATORY

81 Cornell Ave., Bldg. 120
P. O. Box 5000
Upton, NY 11973-5000
Phone 631 344-8107
Fax 631 344-6079
bhooda@bnl.gov

Managed by Brookhaven Science Associates
for the U.S. Department of Energy

Memo

Date: ***October 22, 2010***

To: ***Robert Deschamps***

From: ***Benny Hooda***

Subject: ***NESHAPs Assessment of Bldg. 705 Stack Remedial Actions***

A National Emission Standard for Hazardous Air Pollutants (NESHAPs) evaluation was completed for the demolition of the Building 705 Stack, silencer, removal of the base, baffle plate, ducts, drains, platforms, and associated soils. The 'End State' requires the decontamination and demolition (D&D) under the Area of Concern (AOC) 31, Record of Decision (ROD) agreement.

Attachment I, Facility/Process Radionuclide NESHAPs Evaluation, provides the technical information regarding the radionuclide source term and the ventilation system for the remediation project. Attachment II, the synopsis report from CAP88-PC, Version 3.0, Modeling Program, provides a conservative estimate of the effective dose equivalent of 5.35E-05 mrem/year to the Maximally Exposed Individual (MEI) at the south-southeast location.

The potential effective dose equivalent from the Stack demolition and removal of other structures was well below the 10 mrem/year annual limit as specified in the 40 CFR 61, subpart H, and well below the 0.1mrem/ yr. limit, which would require a NESHAPs permit. Although a NESHAP permit is not required, continuous sampling of the fugitive particles near work activities, inside the base tent, and emissions in the vicinity of HEPA/Torit system shall be implemented for dose-risk calculations. Also, the dose to members of the public and emissions into the environment shall be kept as low as reasonably achievable (ALARA) in accordance with the BNL policy.

If you have any questions, please contact me on extension 8107.

BH:mjt

Attachments

Distribution:					
	C. Armitage	S. Coleman	G. Goode	B. Lee	A. Lockwood
	F. Mitchell	T. Jernigan	D. Ryan	C. Schaefer	J. Terranova

EC72ER.10

* * *

ATTACHMENT I

FACILITY/ PROCESS RADIONUCLIDE NESHAPs EVALUATION

Prepared by
Benny Hooda
October 22, 2010

1. SOURCE NAME AND LOCATION

Name: The Stack Demolition Project
Location: Building 705
Brookhaven National Laboratory (BNL)
Upton, NY 11973
Latitude: N 40^0 52'
Longitude: W 72^0 53'

Building 705 is a 320-ft high exhaust Stack located approximately 280 ft west of the High Flux Beam Reactor (HFBR), and 775 feet northwest from the corner of Cornell Avenue and the Renaissance Street (Figure 1). The Building 705 Stack and associated underground utilities are considered a part of the HFBR complex for remediation activities. Under the Area of Concern (AOC) 31, Record of Decision (ROD), the remedial actions require that the 'End State' of the Stack and associated utilities require decontamination and demolition (D&D) of the structures. The D&D will be completed down to the pedestal, and includes the stack, base, baffle plates, ducts, drains, platforms, and the entire section of the underground plenum silencer. The associated HFBR contaminated utilities and soils are also a part of the D&D project, and therefore, are included in the evaluation.

Figure 1. Location of Building 705 Stack and HFBR

2. RELEASE POINT INFORMATION

Location:	Bldg. 705 Stack
Release height (m):	Ranges from the top (98 m) of the Stack up to grade level
Stack surface area (m^2):	2099 (Truncated cone)
Stack diameter (m):	5.61 (Area source, at the top)
Exhaust velocity (m/sec):	N/A (Stack demolition)
Exhaust temp. (^oF):	Ambient

3. TECHNICAL INFORMATION ABOUT THE SOURCE

a. Overview of the Project

The Stack was constructed in the late 1940’s to discharge the effluents from the Brookhaven Graphite Research Reactor (BGRR) and to ventilate the equipment and rooms of Building 801. Over the years, other BNL facilities such as Building 750, Building 811, Building 815, Building 830, and Building 901A were connected to the large Stack via underground duct work. In April 2009, a ROD for the AOC 31 was finalized, and included the demolition of the Stack, silencer, removal of HFBR underground utilities, and contaminated soil.

The Stack was constructed using an isometric wire frame and was fabricated with poured in reinforced concrete. The original design drawing showed an overall stack height of 320 feet (97.54 m) above grade, a conical shape that varies in thickness from 14 in. at the base to 7 in. at the top (Figure 2). The Stack interior base diameter is of 26 ft 7 in. (8.10 m) and the interior top diameter is of 18 ft, 5 in (5.61m). The conical portion of the stack is 298 ft 6 in. (90.98 m) long and rests atop of an octagonal reinforced concrete pedestal (Figure 3). The pedestal supports the Stack cone and the frame of the underground plenum. The pedestal is 21 ft 6 in. (6.55 m) tall with an interior diameter of 26 ft (7.92 m) and exterior width of 30.5 ft (9.30 m).

The Stack’s exterior components, such as the lightening protection system, strobe lights, steel platforms, and ladders will also be disposed. The interior of the Stack contains several components including a large baffle plate, two metal ducts, and a series of three drains. There are also two interior ducts within the Stack. A large duct with a 42-in diameter made of 3/8 in. of thick steel enters the Stack pedestal roughly 2 ft 6 in. above the Stack foundation. The 42-in.duct, after entering the Stack, makes a 90° vertical bend and then discharges straight up. The second is a smaller interior duct of 14-in. diameter, 10 gauge stainless steel acid fume duct that enters the Stack roughly 6 ft above the top of the Stack foundation. The 14-in. diameter duct makes four bends and then runs up along the entire interior length of the Stack and terminates by making two vertical bends away from the wall to the center of the Stack outlet. The 14-in. duct is secured to the Stack wall every 20 ft with stainless fasteners.

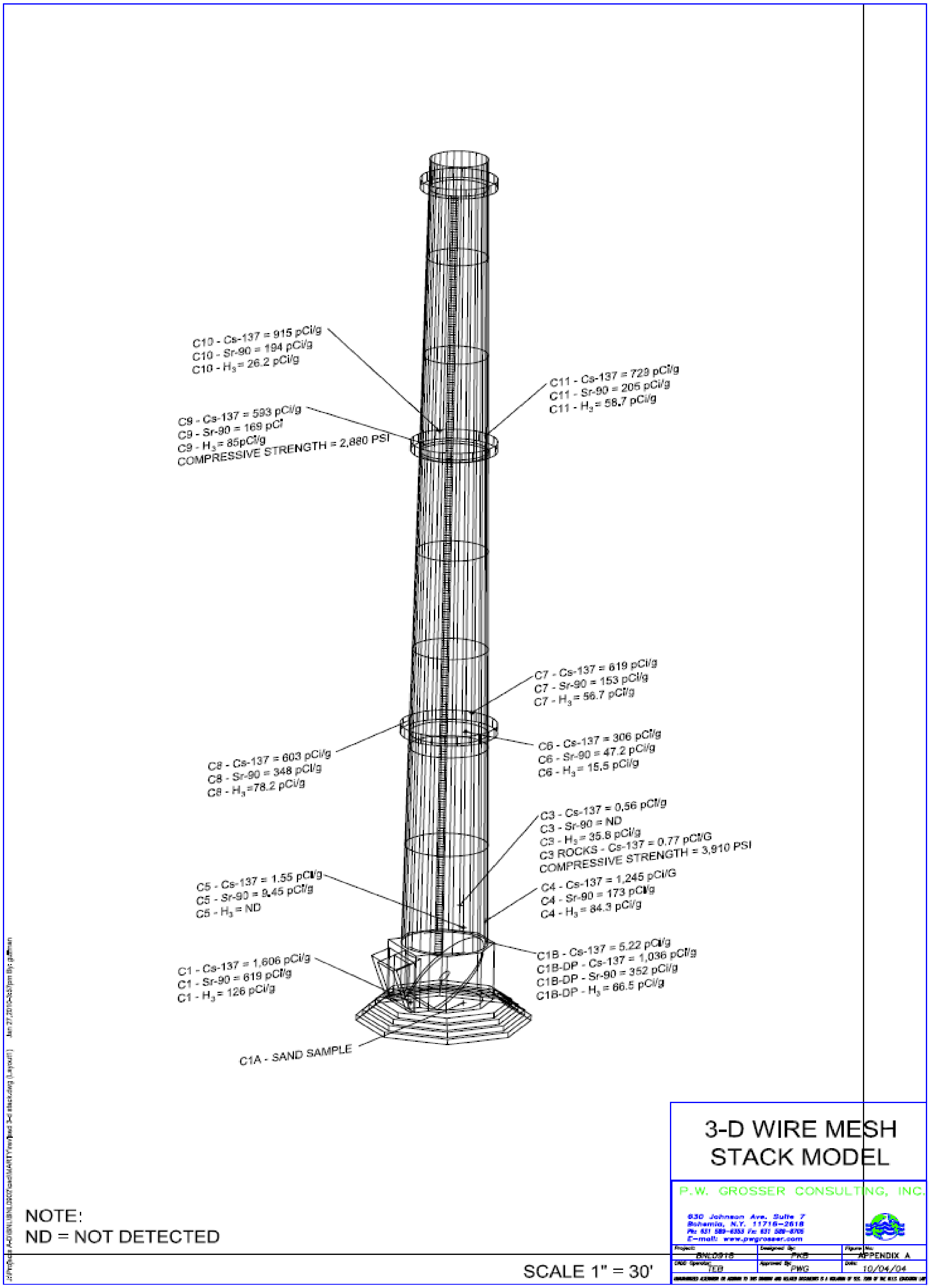

Figure 2. The Stack Wire Mesh and Characterization Data

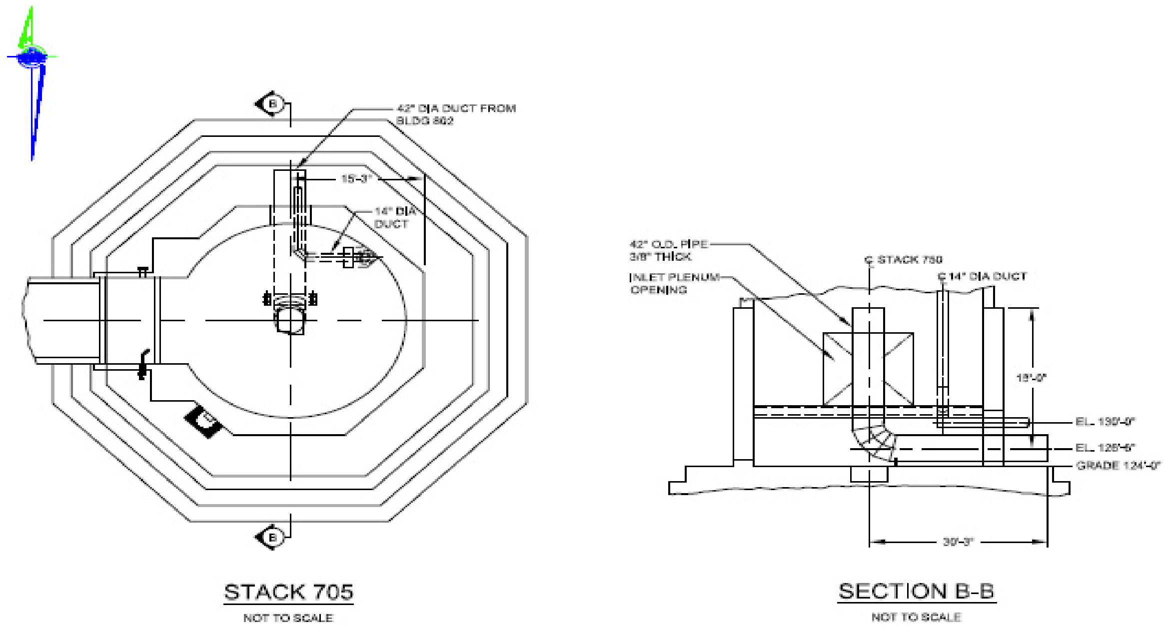

Figure 3. The Stack Pedestal and Ducts

When the engineering controls, appropriate work and safety plans, and mobilization is complete, the base of the Stack will be coated with 2 in of bituminous concrete to prevent the spread of contamination to the ground. A Mastclimber shall be erected that is anchored to the stack. A hoist system to move supplies and personnel will be engineered adjacent to the decontamination unit and at the base of the Stack. Demolition of the Stack will be accomplished by using a hydraulic shear, working from the top of the Stack and progressing downward toward the base. A moveable trolley and trolley beam will allow the mechanical pulverizer to be positioned around the circumference of the Stack as the demolition progresses from top to bottom. In addition, a “bull pen” will be coordinated with Radiological Control and installed at the platform perimeter, or where it is determined to be the best location. Herculite or poly will be placed on the deck of the platform to protect the deck surface from contamination. The device will shear the Stack concrete into small pieces, approximately the size of a base ball. The pulverized concrete rubble will be knocked inside, allowing it to freefall to the bottom. To control dust and suppress the particulate matter from becoming airborne, a fixative shall be applied to the inside of the stack before the initiation of the demolition work. If dust is still visible during the pulverizing process and it is determined that the dust is not pulled by the negative pressure inside the Stack, a light mist of water will be sprayed continuously to the areas of the Stack that are being pulverized.

The base of the Stack and silencer will be demolished with excavators equipped with hammers, pulverizers, grapples, and buckets. A Skidsteer machine will be used to load the concrete rubble and debris into DOT-approved waste containers for proper off-site disposal. The ‘End State’ of the Stack under the HFBR ROD requires removing the Stack to the pedestal, completing the removal of the ducts and pipes, and the associated contaminated soils. Transportation of the radioactive waste will be done with the waste manifest and the waste acceptance criteria of the off-site disposal site. The work completion and removal of all the contamination shall be confirmed independently through characterization, verification, and an area survey project.

b. Ventilation Systems

At the base of the Stack, a tent of approximately 40 ft by 60 ft, with a height of 25 to 30 ft shall be erected and attached to an opening in the Stack. The tent will be maintained at negative pressure during the contaminated waste loading activities.

A Torit dust collector (Figure 4) will be utilized to collect the dust generated during the demolition work. The Torit is a 12,000 cfm system with 32 filter cartridges which will maintain the Stack under negative pressure. A 24-in diameter duct will connect the Torit to the Stack and another 24-in diameter duct will connect the containment tent to the Torit. A HEPA filtration (99.7 percent efficient to 0.3 micron) system will be attached downstream of the Torit exhaust. The ventilation system will provide a complete air change every ~16.25 minutes or four air changes every hour for both the Stack and tent, when operated simultaneously. Otherwise, there will be six air changes per hour when the Stack only is kept under negative pressure during demolition activities. The capture velocity may not be sufficient to remove all dust particles and, therefore, a light mist of water will be sprayed to minimize airborne dust.

Figure 4. Torit Dust Collector

At a minimum, three continuous air effluent samplers to sample the ambient air shall be operated during the Stack demolition activities: 1) at the top of the Stack downwind from the mechanical pulverizer; 2) inside the base tent; and 3) in the immediate vicinity of the HEPA filter effluents to monitor the air emissions and fugitive dust releases. The filter sampling media shall be analyzed by alpha spectroscopy for Am-241, Pu-238/239/240, low energy beta for Sr-90 and Ni-63, and low energy gamma on the rest of Table 3 source term radionuclides. The frequency of analysis for the HEPA-filtered effluent sampler shall be weekly, and for samplers at the top of the Stack and in the tent, on a daily basis during the demolition work activities. The samples will be screened on site with a calibrated detector and analyzed by a certified, off-site analytical services laboratory.

c. Source Term

The source term for the Stack and Pedestal remediation action was developed based on the radionuclides characterization data in the concrete core samples collected at various (¼ to ¾ in) depths of the Stack (Table 1) from the Reference 3, and the radionuclide characterization results of the plenum sediments from the silencer (Table 2). The Cs-137, Sr-90 and H-3 radionuclides were measured at ¼ to ¾ in. depth in the concrete core samples inside the Stack. The volume of material at risk was estimated using the upper (9.42 ft) and the base (13.58 ft) radii of the Stack and by a straight line approximating the inner surface of the structure between the base and the upper radii of a truncated cone. The inner cone has the inside radius of the stack opening throughout its length. The outer cone has the radius of one in (0.0833 ft) greater than the inner cone radii. The height of each cone is the same (298.5 ft, height or distance apothem). The volume of the outer cone minus the volume of the inner cone provides an estimate of the potentially contaminated concrete in the Stack, which was defined as a truncated cone. The concrete density used to calculate the source term was 6.57E+4 g/ft^3.

The volume (V) of the Stack was calculated with the concentric truncated cone equation:

$$V = (\pi \times h \div 3) \times (R^2 + r^2 + R \times r)$$

Where:
R = base radii
r = upper radii
h = height or distance between the base and the top circles.

The volume of the outer truncated cone = 127, 103.35 ft^3.
The volume of the inner truncated cone = 125, 371.86 ft^3.
Therefore, the potentially contaminated concrete from the Stack = 1731.49 ft^3.
The mass of total contaminated concrete in the Stack = 1.113+05 kg.

In estimating the mass of the contaminated concrete at the base of the Stack, it was assumed to be two concentric cylinders with the outer cylinder 1 in (0.0833 ft) wider than the inner cylinder (13 ft radius). The volume of the contaminated concrete was calculated as the difference in the volume of the two cylinders. The base height was taken as 21.5 ft and the concrete density used was the same as earlier, 6.57E+4 g/ft^3.

The volume of outer cylinder = 11, 561.73 ft^3.
The volume of inner cylinder = 11, 414.98 ft^3.

Therefore, the potentially contaminated concrete at the base of the Stack = 147 ft^3.
The mass of total contaminated concrete from the pedestal base = 9.64E+03 kg.
The total mass of the contaminated concrete from the remediation project = 1.23E+05 kg.

The interconnecting underground ducts from building 750, building 801, and building 802 are contaminated with tritium, Co-60, Ni-63 and Cs-137. The total radioactivity in these ducts was estimated to be 0.1 curies.

The underground D/F double-walled waste line, which runs between Building 750 and Building 801, is also contaminated with H-3, Co-60, Ni-63, and Cs-137. Based on data provided on the NESHAP assessment form, the D/F waste lines contamination was estimated to be 0.1 curies.

Table 1. Analytical Results of Stack Concrete Core Samples

Location (penetration depth in inches)	Cs-137 (pCi/g)	Sr-90 (pCi/g)	H-3 (pCi/L)
Stack Pedestal (¼”)	1210	486	117
Stack Pedestal (½ ”)	65	90	96
Stack Elevation 145.5’ (¼”)	349	61	28
Stack Elevation 225.5’ (¼”)	445	183	50
Stack Elevation 225.5’ (½ ”)	14	54	29
Stack Elevation 225.5’ (¾ ”)	6	38	24
Stack Elevation 333’ (¼”)	659	196	57
Stack Elevation 333’ (½ ”)	3	17	214

Table 2. Analytical Results of Plenum Sediment (COC# 28715-08)

Radionuclide	Activity (pCi/g)	Removable Activity (Appendix A)	Activity (pCi/g)
H-3	473	0.61%	2.89
Sr-90	7730	24.6%	1902
Cs-137	35400	45.5%	16,107
Eu-152	67.9	0.23%	0.16
Eu-154	40.6	0.16%	0.07
Eu-155	18.1	0.01%	0.00
Pu-238	19.4	0.83%	0.16
Pu-239/240	1230	0.83%	10.21
Am-241	183	0.20%	0.37
U-238	10.8	0.02%	0.00

The radionuclide characterization results from the plenum sediment before the silencer (Table 2) were used as the basis to estimate the material at risk for the alpha emitter radionuclides. The BGRR fuel failures in the past require that alpha emitting radionuclides be included along with the gamma spectroscopy of the concrete core samples. In order to estimate the source term activity for the alpha emitters, a percentage of the average removable contamination was taken from the Appendix A, Table A-1 of the BGRR Technical Basis Document for Contamination Control Instrument, as given in Column 3 of Table 2 of this report.

The source term release fraction is the amount of radiological material at risk that has the potential to become airborne when the engineering barriers and other mitigating factors are not utilized; this gives a very conservative dose-risk estimate to members of public. The following assumptions were made in calculating the source term for input into the CAP-88 PC, version 3.0, dose model program. Table 3 provides a list of radionuclides used as the input, with their respective emission quantities.

Assumptions:

1. The material at risk was maximum activity in the materials available for dispersion by some mechanical physical stress upon it.
2. All radionuclides and the quantities characterized were taken as the materials at risk and, therefore, source reduction due to engineering barriers and other mitigating factors were not utilized in the emission source term calculations.
3. Release rate into the environment was adjusted for particulate solid state of the radionuclides in accordance with the NESHAP, Appendix D.
4. The airborne released and respirable fractions were assumed to be one.
5. Particle size corrections for inhalation were not factored in the source term calculations.
6. The aerodynamic entrainment, re-suspension, and coagulation of particulates were not factored in the source term calculations.
7. Release rate reductions due to filtration, fallout, surface adhesion, fixative sealant, gravitational settling, plateout, and other particle size effects were not factored in the source calculations.

Table 3. Emission Source Term

Radionuclide	Maximum Activity (pCi/g)	Releasable Activity (Ci)	Appendix D Factor	Source Term for Dose calculations
H-3	214	2.63E-02	1.0	2.63E-02
Co-60	-	1.00E-01	1.0E-03	1.00E-04
Ni-63	-	1.00E-01	1.0E-03	1.00E-04
Sr-90	1902	2.34E-01	1.0E-03	2.34E-04
Cs-137	16,107	1.98	1.0E-03	1.98E-03
Eu-152	0.16	1.97E-06	1.0E-03	1.97E-09
Eu-154	0.07	8.61E-06	1.0E-03	8.61E-09
Pu-238	0.16	1.97E-05	1.0E-03	1.97E-08
Pu-239/240	10.21	1.16E-03	1.0E-03	1.26E-06
Am-241	0.37	3.70E-05	1.0E-03	3.70E-08

d. Dose Assessment

Radiological dose and risk assessment to the maximally exposed individual (MEI) was estimated using the Clean Air Act Code CAP88-PC, version 3.0 modeling program. The meteorological data (temperature, precipitation, wind speed, and mixing height) used in the modeling program was site specific. Because the dispersion of the particulate matter would be minimal due to the application of latex fixative to the source and mostly in proximal areas of remediation, it was assumed that the agricultural pathway would not be affected; therefore, a default option of importation was used in the model for the vegetation pathway. Also, because Suffolk County does not have any dairy or cattle farms, 100 percent of milk and meat was imported from outside of the assessment area.

The CAP88-PC model is based on the Gaussian plume model with certain limitations. The dose risk estimates in a CAP88-PC model are applicable to low levels of chronic exposures and not applicable to short-term or acute exposures. Therefore, it was assumed that the low-level emissions from the source are continuously emitted over the course of a year. The HEPA-filtered exhaust from the Torit discharged into the environment shall be sampled with an ambient sampler, as stated earlier. The fugitive fine particle losses at the top of the Stack shall also be monitored for dose/risk calculations.

The effective dose to the MEI resulting from the Stack, silencer, and other structure demolition was calculated to be 5.35E-05 mrem/year. The potential dose was below the 10 mrem/year annual limit as specified in the 40 CFR 61, subpart H, and below the 0.1mrem/ yr limit, above which a NESHAPs permit and continuous monitoring of emissions is required.

The Stack, silencer, and associated utilities demolition is exempted from the NESHAP permit application requirements because these are CERCLA decommissioning and decontamination activities. Nonetheless, all applicable requirements, criteria, and best management practices and standards should be implemented for the Stack demolition project. One such criterion is the continuous sampling and monitoring for the airborne radioactive emissions. Ambient air in the vicinity of remedial activities should be monitored for fugitive dust particulates to ensure that the public and non-involved workers in the surrounding areas are not exposed to ambient air concentrations that could exceed the established regulatory dose limits. Periodic monitoring results will be submitted to the Environmental Protection Division (EPD) in an acceptable format for regulatory reporting to EPA and for independent data review. Any unplanned, non-routine incidents should also be reported EPD as soon as possible for timely notification to regulatory authorities. BNL's policy of keeping the dose-risk as low as reasonably achievable (ALARA) should be implemented during the Stack demolition work activities.

References:

1. The Standard Based Management System, Radiological Airborne Emissions Subject Area's Completed NESHAPs Assessment Form.
2. Final Record of Decision for Area 31- High Flux Beam Reactor (HFBR), BNL, Upton NY. February 2009.

3. Final Characterization for Brookhaven National Laboratory High Flux Beam Reactor, prepared for Brookhaven National Laboratory by WMF, Inc. (WMG Report 6117-RE-072), Peekskill, NY. February 2007.

4. Clean Air Act Assessment Package, CAP88-PC Version 3.0 Dose Modeling Program. 1988.

5. ANSI/HPS. 1999. "Sampling and Monitoring Releases of Airborne radioactive Substances from the Stacks and Ducts of Nuclear facilities." N13.1-1999.

6. BNL-ESD-01, Quality Assurance Plan: Radiological Air Emissions at BNL.

7. The High Flux Beam Reactor Project's Hazard Assessment Document. June 2008.

8. The truncated cone volume calculator at www.aqua-calc.com.

9. The BGRR technical basis Document for Contamination Control Instruments, Appendix A, Table A-1.

ATTACHMENT II

C A P 8 8 - P C

Version 3.0

Clean Air Act Assessment Package - 1988

S Y N O P S I S   R E P O R T

Non-Radon Population Assessment
Oct 15, 2010 08:23 am

Facility: Building 705- Large Stack
Address: HFBR- Brookhaven National Laboratory
P.O.Box 5000
City: Upton
State: NY Zip: 11973

Source Category: Area
Source Type: Area
Emission Year: 2010

Comments: Demolition of the Large Stack
Building 705 Stack, Silencer, and other Structures

Effective Dose Equivalent
(mrem/year)

5.35E-05

At This Location: 1400 Meters South Southeast

Dataset Name: Large Stack
Dataset Date: 10/15/2010 8:17:00 AM
Wind File: Z:\CAP88PC2\CAP88PC2\WNDFILES\BNL00.WND
Population File: Z:\CAP88PC2\CAP88PC2\POPFILES\BNL10.pop